REMARKS

This application contains claims 1, 19, 20, 32-40, and newly added claims 41-44. In the last Office Action, the claims were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,831,797 to Schaenzer et al. ("Schaenzer") in view of U.S. Patent No. 5,808,973 to Tanaka ("Tanaka"). The Examiner stated that Schaenzer discloses all features of the claimed invention with the exception of providing a solid immersion lens 51 in an upper surface of a slider rather than forming a probe having a microscopic aperture in the bottom surface of the slider. Tanaka was cited as disclosing this feature. In view of this disclosure, the Examiner has taken the position that it would have been obvious to replace the solid immersion lens of Schaenzer with the microscopic aperture of Tanaka since these components are art recognized equivalents.

By the present response, claims 1 and 19 have been amended in minor respects to recite that the distance between the microscopic aperture and the recording medium is smaller than a distance between a part of the bottom surface of the slider closest to the recording medium and the recording medium so that the microscopic aperture can be brought to within several nanometers to several tens of nanometers close to the recording medium to enable high resolution optical reading and/or recording of data on the recording medium.

Applicants respectfully submit that amended independent claims 1 and 19, dependent claims 20 and 32-40, and newly added claims 41-44 patentably distinguish over the prior art of record.

The present invention relates to a near-field optical head for a recording device having a slider on which a probe is provided, the probe being comprised of a microscopic aperture protruding from a bottom surface of the slider and closely spaced from a recording medium by an air gap formed between the recording medium and the bottom surface of the slider. Near-field light is produced or scattered by the microscopic aperture, and the recording medium and the microscopic aperture interact through the near-field light when the slider undergoes scanning movement relative to the recording medium to effect recording or reading of information on the recording medium.

More specifically, amended independent claim 1 recites that the probe comprises a microscopic aperture protruding from a bottom surface of the slider for producing or converting near-field light without use of a lens. Claim 1 further requires that a distance between the microscopic aperture and the recording medium is smaller than a distance between a part of the bottom surface of the slider closest to the recording medium and the recording medium so that the

microscopic aperture can be brought to within several nanometers to several tens of nanometers close to the recording medium to enable high resolution optical reading and/or recording of data on the recording medium.

Amended independent claim 19 contains similar language. In particular, claim 19 recites a near-field optical head having a support member and a probe protruding from a bottom surface of the support member and having a microscopic aperture formed therein for producing or converting near-field light without use of a lens such that a part of the bottom surface of the support member closest to a sample is more distant from the sample than the probe so that the microscopic aperture can be brought to within several nanometers to several tens of nanometers close to the sample.

As demonstrated hereinafter, applicants respectfully submit that neither of independent claims 1 and 19 is rendered obvious by the prior art of record because the secondary reference to Tanaka does not suggest modifying the probe of Schaenzer to form a microscopic aperture protruding from the bottom surface of a slider as recited by each of independent claims 1 and 19.

More specifically, amended independent claims 1 and 19 recite that a microscopic aperture protrudes from the bottom surface of the slider so that a distance between the

probe and the recording medium is smaller than a distance between a part of the bottom surface of the slider closest to the recording medium and the recording medium so that the microscopic aperture can be brought to within several nanometers to several tens of nanometers close to the recording medium to enable high resolution optical reading and/or recording of data on the recording medium. Accordingly, the invention recited by amended independent claims 1 and 19 has a microscopic aperture which protrudes below a bottom surface of a slider so that the microscopic aperture can be brought to within several nanometers to several tens of nanometers close to the recording medium or sample.

Schaenzer discloses a near-field recording head having a near-field probe 30 mounted to a slider 20. The near-field probe comprises a solid immersion lens formed by a lens cap 50 disposed on a top surface of the slider and the body of the slider 20, and electrical conductors 52 formed in the shape of a coil. The conductors 52 are coiled about a mesa 54 which is carried on an air bearing surface 56 of the slider. Accordingly, the mesa 54 is provided in the near-field probe 30 of Schaenzer to enable the conductors 52 to be formed into a coil as illustrated in the sectional view of Fig. 2 of Schaenzer. The mesa 54 is not provided for the

purpose of serving as a near-field probe, which purpose is performed by the solid immersion lens 51.

As pointed out by applicants in their specification, a conventional recording device employing a flying head configuration produces a film of air between a lower surface of a recording head serving as an air bearing and the surface of a recording medium. The distance between the air bearing surface of the recording head and the surface of the recording medium is as much as several dozen to several hundred nanometers.

When attempting to employ a flying head configuration in a near-field recording device, high resolution and high efficiency recording and reading of data utilizing near-field light is not attainable. One reason for this is that a distance of several dozen to several hundred nanometers between the air bearing surface of the recording head and the recording medium is too large to obtain the high-intensity near-field light needed for high resolution. The intensity of near-field light decreases exponentially as distance increases. Since the recording head and the recording medium are spaced far from each other relative to the wavelength of near-field light, only low intensity near-field light can be produced. Thus, near-field light having an intensity sufficient to achieve high resolution recording or reading of data is not attainable.

Thus, if a flying head configuration is adopted for use in a near-field recording apparatus, such a recording apparatus must be provided with a light emitting element or light detecting element positioned on the top surface of the recording head opposite the air bearing surface having a microscopic aperture provided therein. The distance between the aperture and the light emitting or detecting element is equal to the thickness of the slider of the flying head. Typically, this distance is large, such that the intensity of light illuminating the microscopic aperture by a light emitting element (or illuminating the light detecting element from the microscopic aperture) is small because the intensity of such light decreases proportionately with the square of the distance.

Schaenzer overcomes this problem by forming electrical conductors 52 in the shape of a coil about a mesa 54 for the purpose of heating a small spot on a recording medium to record information thereon.

On the other hand, the present invention overcomes the foregoing problem in an entirely different manner by forming a microscopic aperture to protrude below the bottom surface of the slider to increase the amount of energy produced by near-field light. In this manner, the present invention avoids the need for the mesa-and-coil structure of Schaenzer.

The only motivation for replacing the solid immersion lens and coil-and-mesa structure of Schaenzer with a microscopic aperture protruding below the bottom surface of the slider is provided by applicants' specification, which discloses that such modification enables efficient use of near-field light for reading and writing of data to a recording medium. Tanaka provides no such motivation.

In particular, Tanaka would not have motivated one of ordinary skill in the art to modify the probe 30 of Schaenzer to provide a microscopic aperture protruding below the bottom surface of the slider. Although Tanaka discloses a microscopic aperture formed in a substrate and would have fairly suggested replacing the near-field producing components of the Schaenzer probe therewith, such components do not include the mesa 54 since the mesa 54 is formed below the near-field producing components of the probe solely to enable formation of the coil.

Stated otherwise, even if Schaenzer were modified to incorporate the microscopic aperture of Tanaka as urged by the Examiner, such modification would not result in a microscopic aperture protruding below the bottom surface of the slider. The only motivation for such structure is found in applicants' specification, which cannot be used in a hindsighted manner to serve as the basis for an obviousness rejection.

The present invention enables use of the flying head configuration in a near-field recording apparatus by forming a probe of a microscopic aperture protruding from a bottom surface of a slider. A gap is formed between a recording medium and the bottom surface of the slider. Near-field light is produced or converted into propagation light by the microscopic aperture, and the recording medium and the microscopic aperture interact through the near-field light when the slider undergoes scanning movement relative to the recording medium to effect recording or reading of information on the recording medium.

For the foregoing reasons, Tanaka does not suggest modifying the structure of Schaenzer to provide a microscopic aperture protruding from the bottom surface of a slider. Even if Schaenzer were modified to provide the microscopic aperture of Tanaka in the slider, this modification would not result in a microscopic aperture protruding from the bottom surface of the slider as required by independent claims 1 and 19.

Newly added dependent claims 41 and 43 recite that the slider or support member has a reduced thickness portion in which a through-hole is formed terminating in the microscopic aperture and a light source mounted to a top surface of the reduced thickness portion of the slider or support member. Neither Schaenzer nor Tanaka discloses

providing a through hole in a reduced thickness portion of a slider and mounting a light source thereon.

Accordingly, applicants respectfully submit that claims 1, 19-20 and 32-44 patentably distinguish over the prior art of record and that the rejections under 35 U.S.C. §103(a) should be withdrawn.

In view of the foregoing amendments and discussion, the application is now believed to be in condition for allowance. Accordingly, favorable reconsideration and allowance of the claims are most respectfully requested.

Respectfully submitted,

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November 5, 2003
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